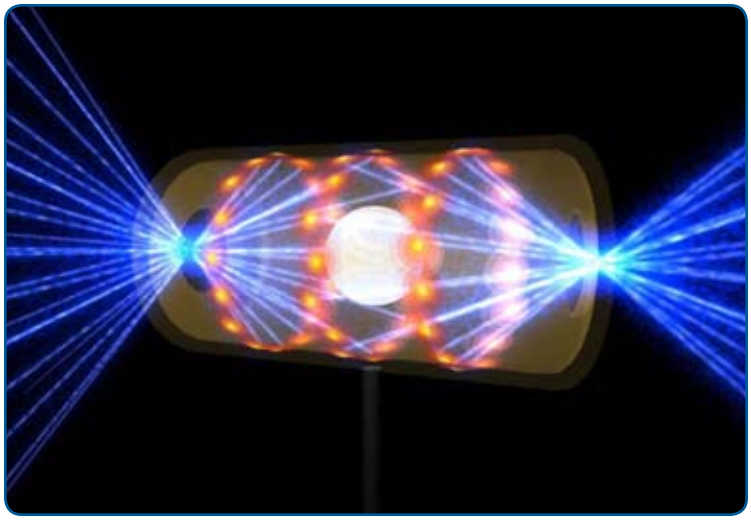
NIF
National Ignition Facility

The LIFE Project Plan

Thanks to advanced U.S. technologies and materials, an idea that is more than 50 years old is now within reach. The fusion-fission concept, embodied in LIFE, may well provide a considerable fraction of the nation's – and the world's – energy needs this century. At the same time, it could significantly reduce the amount of spent nuclear fuel awaiting long-term geologic storage.

Recent progress on the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL) and on the physics and technologies of inertial confinement fusion, diode-pumped solid-state laser technologies and materials science for applications in the nuclear environment, in the United States and elsewhere around the world, promise to bring us closer to realizing the long-standing vision of fusion-fission energy.



A NIF Target

This artist's rendering shows a NIF target pellet inside a hohlraum capsule with laser beams entering through openings on either end. The beams compress and heat the target to the necessary conditions for nuclear fusion to occur. Ignition experiments on NIF will be the culmination of more than 50 years of inertial confinement fusion research and development.

Demonstration of fusion ignition on NIF is expected in 2010-2011. The LIFE development team is now preparing a "point design" and development plan to demonstrate the associated inertial fusion energy (IFE) and nuclear reactor technologies. The plan includes a LIFE pilot plant for laser and materials testing in the 2020 time frame, followed by a demonstration commercial power plant in 2030.

The science and technology for an integrated demonstration of the LIFE engine can be performed at the modular level in subscale facilities. For example, the design of the targets and demonstration of the required fusion gain can be done independently of the fission process.

LLNL researchers expect to demonstrate the physics of fast ignition on NIF within the next few years. Target production and delivery can be developed and demonstrated independently. A proof-of-principle LIFE fission cycle (from startup through greater than 99 percent fuel burnup) could be demonstrated with a one-fifth scale LIFE engine within less than ten years.

A Secure and Sustainable Energy Future

In the baseline scenario, LIFE would provide 1,000 gigawatts of electricity (about one-third of U.S. electricity demand) by 2100. Achieving this goal requires building five to 12 plants annually beginning in 2030. (It is assumed that LIFE plants can be built in five years and no advanced light water reactors (ALWRs) would be built after 2035.)

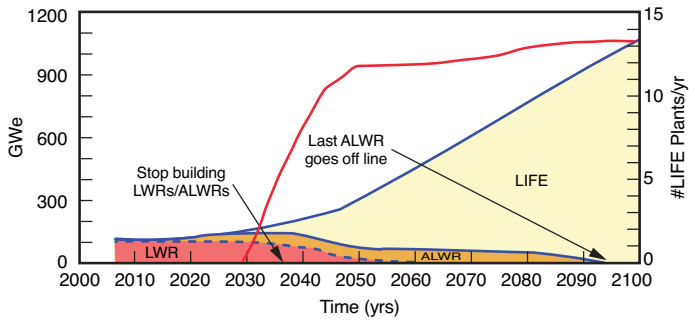
A more ambitious scenario would supply about two-thirds of the nation's electricity demand by 2100 as well as 50 percent of the nation's hydrogen. This high scenario would require construction of 15 to 20 new LIFE plants per year beginning in 2030.

LIFE PROJECT PLAN

LIFE could meet U.S. electricity needs from two nuclear waste streams: spent nuclear fuel (SNF) and depleted uranium (DU). The nation currently has about 53,000 metric tons (MT) of SNF and about 550,000 MT of DU. In the LIFE base scenario, the waste generated by LWRs and ALWRs grows to about 120,000 MT of SNF and 1 million MT of DU by about 2030. By the end of life of the last ALWR (around 2090), the totals approach 190,000 MT of SNF and 1.5 million MT of DU. The 190,000 MT of SNF could supply U.S. electric needs for several hundred years. When that waste stream is exhausted, the approximately 1.5 MT of DU could provide two trillion watts of electricity (estimated U.S. electricity demand in 2100) for close to 1,000 years.

LIFE technology offers a promising pathway for the expansion of nuclear power around the world. Proliferation concerns are greatly mitigated relative to other nuclear technologies, and nuclear fuel is inexpensive and widely available. LIFE engines would also help mitigate potential climate change because, like other nuclear power plants, they would emit no carbon dioxide or other greenhouse gases. Successful development of the LIFE engine would allow the United States to maintain global leadership in the development of new energy technologies and strengthen American economic competitiveness.

LIFE electricity demand scenarios and fuel end-of-life analysis



Transition Scenario

A scenario for transition from a LWR fleet to LIFE engines, with no LWR plants built after 2035. In this scenario, 50 percent of the projected U.S. electricity demand (1 TW) would be supplied by LIFE engines burning DU and/or SNF by 2100.